Food Quality and Preference 113 (2024) 105040

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Which factors affect the Italian consumer's intention to insect-eating? An application of an integrated attitude-intention-eating model

Valentina Maria Merlino [a,1,*], Oriana Mosca [b,1], Ferdinando Fornara [b], Rocco Roma [c], Elisabetta Bonerba [d], Achille Schiavone [e], Rosa Laura Passaro [e], Martina Tarantola [e]

[a] Department of Agricultural, Forest and Food Sciences, University of Turin, Turin, Italy
[b] Department of Education, Psychology, Philosophy, University of Cagliari, Cagliari, Italy
[c] Department of Soil Plant and Food Sciences, University of Bari Aldo Moro, Bari, Italy
[d] Department of Veterinary Medicine, University of Bari Aldo Moro, Bari, Italy
[e] Department of Veterinary Sciences, University of Turin, Turin, Italy

ARTICLE INFO

Keywords:
Novel food
Neophilia
Animal welfare
Visual intention
Socio-psychological factors
Structural Equation Modeling

ABSTRACT

This research explored the role of key socio-psychological dimensions on individuals' intention to eat insect-based foods (IEIBF). In particular, the theoretical framework included biospheric values and social norms, whose impact on pro-environmental choices has been largely evidenced, but also those factors related to animal welfare and neophobia/neophilia attitudes. An online survey was carried out in different Italian regions intercepting 1402 individuals to verify the relationships predicted by our proposed model, i.e. the Integrated Sustainable Neophilic Insect-based Eating Model (ISNIEM), for predicting IEIBF. Participants completed a survey containing measures of IEIBF, biospheric values, general pro-environmental beliefs, attitude toward sustainability, food neophilia, concern for insect welfare, and social norms (both injunctive and descriptive). Structural Equation Modelling (SEM) technique was used for testing the ISNIEM. The main findings show that individuals having higher concern about environmental and ethical sustainability are more open to eating insects, especially if the latter are treated ethically. Overall, these results suggest that a typical consumer of insect foods is likely to be driven to their consumption from one side by curiosity (related to the neophilia dimension), and from the other side either by the sense of responsibility towards the environment or by the concern for ethical issues (i.e., animal welfare). The integrated attitude-food-intention model used to explore intention to eat insect foods (IEIBF) with a visual scheme represents an innovative approach in the study of consumer behaviour.

1. Introduction

The possibility of consuming edible insects has probably crossed the minds of a good portion of European consumers in recent times. While in many countries around the world, this practice is common and rooted in the food tradition (Florença et al., 2022), in the European Union the introduction of the breeding, marketing, and consumption of insects for humans was legalized in 2015 by Regulation (EU) No 2015/2283 and included in the Farm to Fork strategy for their potential positive impact on the sustainable and circular development of the food system, in terms of production and consumption (IPIFF, 2020). To date, four insects' species, mealworms, locusts, crickets, and lesser mealworms are allowed in the EU market as whole and insect-based products (meals and snacks), which are gaining increasing acceptance among consumers as a potential substitute protein source, both as feed and food (IPIFF, 2018). The International Platform on Insects for Food and Feed (IPIFF) estimates an exponential increase in the production and consumption of insect products, which are expected to reach 1 million tonnes and 390 million consumers in 2030, respectively (Demartini et al., 2022; IPIFF, 2019).

However, the acceptability of this new 'future' food is heterogeneous across different parts of Europe (Onwezen et al., 2021). The main barrier to the development of this market is related to consumers' psychological

Abbreviations: **IEIBF**, intention-to-eat insects-based foods; **IBF**, insects-based foods; **SEM**, Structural Equation Modelling; **ISNIEM**, Integrated Sustainable Neophilic Insect-based Eating Model; **FNS**, Food Neophobia Scale.

* Corresponding author.
E-mail address: valentina.merlino@unito.it (V.M. Merlino).
[1] These authors contributed equally to this work.

https://doi.org/10.1016/j.foodqual.2023.105040
Received 21 April 2023; Received in revised form 20 September 2023; Accepted 1 November 2023
Available online 7 November 2023

rejection induced by distaste for entomophagy and unfamiliarity with the product (Lombardi et al., 2019; Onwezen et al., 2021). Modern society perceives insect meat as a high quality product, with good nutritional value in terms of protein and fiber, along with a more sustainable production process (in terms of greenhouse gas emissions, water, and soil use) with respect to other domestic intensive livestock production (Menozzi et al., 2017; van Huis, 2013). Therefore, this meat could be considered an alternative to traditional meat: however, consumer acceptability represents the main barrier to the expansion of this market (Kwiecińska et al., 2017).

Italy is a country where the culinary tradition is extremely deep-rooted, from North to South. The different areas of the country are extremely diverse in terms of socio-demographic composition, lifestyles, and eating styles, but are united by a strong connection with traditional and local ingredients. Several studies have found a negative reaction of Italian consumers to questions about their willingness to try edible insects (Cicatiello et al., 2016; Laureati et al., 2016; Palmieri et al., 2019). However, in the Italian culinary tradition, some products such as *Casu marzu (*cheese with live insect larvae -maggots), *Marcetto* or *Cace Fraceche (*soft cheese with *Piophila casei)*, *Gorgonzola coi grilli* (Gorgonzola with crickets) and *Saltarello* (cheese from Northen Italy region) are famous examples for containing live insect larvae (namely *Piophila casei*) (Balzan et al., 2016). Again, in Italy, other foods that are perceived as disgusting in other places in the world are instead typically linked to culture (rabbit meat, bread with spleen, porcupine meat, horse meat).

At the same time, entomophagy has shown increasing interest in recent years in Italy and other European countries, because of a common need for the integration of new food chains for sustainable development (Fitches and Smith, 2018; Gasco et al., 2019; Lombardi et al., 2019; Palmieri et al., 2023; Santeramo et al., 2018; Schouteten et al., 2016).

In this rapidly changing context, however, the investigation of the socio-demographic and psychological factors that influence people's willingness to include new foods in their dietary patterns is topical and indeed central to the development of new sustainable supply chains (Sottile et al., 2023). Characterizing different profiles of individuals according to characteristics such as neophobia and neophilia, together with their social norms, values, and beliefs, and their sensitivity to ethical attitudes of farming to define their willingness to eat insects, is of crucial importance for the creation of new supply chains and the establishment of an emerging market. For example, perceptions of animal welfare have often been studied as a driver of consumer animal product choice as it defines the degree of preference as well as attitudes toward an animal supply chain (Merlino et al., 2018). However, there is still little knowledge regarding consumer opinions and concerns about insect welfare (Delvendahl et al., 2022).

Furthermore, the right communication according to the target consumers would be a key factor for the success of a supply chain. In general, it is confirmed how the individuals' socio-geometrographic variables affect the perception of food (Merlino et al., 2023). For the insects-based foods (IBF), for example, Myers and Pettigrew (2018) found that communication of positive nutritional aspects and environmental impact does not determine interest in elderly consumers. On the contrary, the willingness to taste insects in the Italian consumer seems to be affected by age and gender, and previous experiences (Balzan et al., 2016; Sogari et al., 2019; Tuccillo et al., 2020). In fact, the higher level of potential acceptability may be associated with young, male, more environmentally sensitive individuals (Caparros Megido et al., 2016; Cicatiello et al., 2016; Verbeke, 2015).

The acceptability evaluation of IBF must involve the understanding the most potentially appreciable aspect of the food (method of preparation, presence of unprocessed or processed insects in the product) would be more effective in defining the acceptability of this emerging supply chain (Materia and Cavallo, 2015; Myers and Pettigrew, 2018; Roma et al., 2020). Indeed, one of the main barriers to insect consumption appears to be the visibility of the whole insect in food (Menozzi et al., 2017; Onwezen et al., 2021; Palmieri et al., 2023).

Consumers' choice orientations and purchasing preferences for insects are far from clear. The impact of the psychological, social, and behavioral barriers on consumers' consumption choices regarding the relative importance of insects is a significant area of investigation.

Therefore, this research aimed to build a consumption model of IBFs based on the hypothesized effect of biospheric values, which are defined as a value orientation in which "people judge phenomena on the basis of costs or benefits to ecosystems or the biosphere" (Stern & Dietz, 1994, p. 70), social norms, neophilia, attitude toward sustainability, and animal welfare perception on the intention to eat insect-based foods (IEIBF). In particular, the research aims and questions are summarized in Table 1.

To reach the research aims, a large national sample of Italian participants (N = 1402) was surveyed. The research questions regard the impact on consumers' choices towards IBF of socio-psychological, attitudinal, and ethical factors, in a mixed approach based on an integrated attitude-intention-eating model (the Integrated Sustainable Neophilic Insect-based Eating Model- ISNIEM), considering the frequency of choice of visual alternatives of insect dishes (visual selection), together with the declared intention, to evaluate IEIBF. In our opinion, this approach could represent the main novelty of the study and an important step forward concerning the scientific literature addressing this topic, expanding previous literature that used a similar approach but applied to willingness to buy food based insects (Piha et al., 2018). On the one hand, the exploration of individual attitudes-behavior toward different issues (sustainability, animal welfare, etc…) with an integrated approach, correlated to a visual-intention measure of consumer, defines a holistic and new model for the study of consumer behavior.

1.1. Theoretical framework, aims and hypotheses

Various analyses of the intention to consume insects were conducted in different countries. We aimed to conduct research focusing on the field of consumer behavior developing a new model of insect consumption (ISNIEM) including biospheric values and social norms, which represent rules or standards for behaviour that serve as guides for people's actions, help create expectations about how others will act and promote greater coordination in social life (Smith, 2020), but also variables that describe the sustainability and animal welfare perception and the neophobia/neophilia attitudes. The development of the model started from the analysis of previous studies in related fields. Choe et al. (2020) examined diners' behavioral intention to visit an edible insect restaurant in South Korea by integrating the theory of planned behavior and the norm activation theory. Their results revealed that the main effect of subjects' intentions derived from individuals' subjective norms, together with attitudes, and perceived behavioral control. In addition, environmental awareness and concern (biospheric values) positively affected personal norms that, simultaneously, positively influenced

Table 1
Research aims and questions.

Research aims	Research questions
To understand the effect of biospheric values on the intention to consume IBF products	Having high biospheric values affect the intention to consume IBF products?
To understand the effect of pro-sustainability attitudes on the intention to consume IBF products	How relevant is the sensitivity towards general environmental sustainability practices on the intention to consume IBF products?
To understand the effect of animal welfare perception on the intention to consume IBF products	How relevant is the sensitivity towards animal welfare on the intention to consume IBF products?
To understand the effect of neophilia on the intention to consume IBF products	How relevant is the neophilia attitude on the intention to consume IBF products?

IBF: insects-based foods.

behavioral intentions.

In another research, de Boer and Aiking (2022) explained how farm animal welfare concerns can be translated into 1) eating less meat, and/or 2) eating "less and better" meat, and/or 3) eating "less worrying" animal protein, implying choices described in the consumer behavior literature. While, as it emerges in this research, the goal of eating less meat is relatively straightforward, the goals of eating "less and better" meat or eating "less worrying" animal protein need more nuance to be assessed in terms of geographic locations. This potential conflict emerges especially in circumstances that require trade-offs between animal protein sources of very different sizes, such as cattle, poultry, and insects (de Boer and Aiking, 2022; Demartini et al., 2022). However, it seems that it is explained how farmed insects are not currently popular as meat substitutes in some countries, but the welfare and ethical issues are gaining increasing attention (de Boer and Aiking, 2022; Hartmann and Siegrist, 2017). In the literature, it is very current the debate whether insects should be treated as "sentient beings" (van Huis, 2019).

Also, Hartmann and Siegrist (2017) have found that, in several EU countries, the willingness to change meat consumption behavior, in terms of reducing or replacing it with insects, is low. Probably because, as the authors hypothize, the consumer awareness of the environmental impact of meat production is surprisingly low. In other studies, despite awareness of the risks of meat consumption on health or the impacts of intensive production on the environment, many consumers choose not to reduce meat intake in their diet (Valli et al., 2021). This can be attributed to the habitual nature of meat consumption (D'Souza, 2022).

Finally, as it is explained by Zielińska et al. (2020), Polish consumers have limited knowledge about entomophagy, and neophobia and low awareness levels are the key barriers to insect consumption. Furthermore, other existing studies have explored the effect of neophobia, familiarity, environmental interest, and convenience on the intention to consume insects (Verbeke, 2015).

Given the many topics covered in the literature in the broad discussion regarding consumer IEIBF, it is necessary to conduct quantitative research on consumer behavior combining the evaluation of different variables (psychological and attitudinal) in a single model.

Accordingly, the research hypotheses of our study are based on an integrated model with a sequential path which includes the following assumptions, stemming from the scientific literature presented in this section and separately evaluating the influence of Social Norms, Biospheric Values, Food Neophilia, Attitude toward Sustainability and Attention to Insect Welfare:

H1: Biospheric Values are positively associated with New Human Interdependence Paradigm (NHIP) that represents the interdependence between human progress and nature conservation.
H2: NHIP is positively associated with a positive Attitude toward sustainability.
H3: A positive Attitude toward sustainability is positively associated with Attention to insects' welfare.
H4: Attention to insects' welfare is positively associated with the Intention to eat novel food, i.e. insects.
H5: The Intention-to-eat insects-based foods (IEIBF) is positively associated with the Number of insects chosen and presented with different images (i.e. visible/not-visible insects).
H6: Social Norms are positively associated with the Number of insects chosen presented with different images (H6a), with the Intention-to-eat insects-based foods (H6b), and with Food Neophilia (H6c).
H7: Food Neophilia is positively associated with the Number of insects chosen presented with different images (H7a) and with the Intention-to-eat insects-based foods (H7b).

Direct paths between non-proximal variables along the sequence were also tested.

2. Method

2.1. Participants

A total of 1402 italian individuals filled in an online questionnaire. The sample was characterized by the prominence of women (69.9 %), with an age varying from 18 to 85 years (mean = 40.68, s.d. = 14.90), a medium–high level of education. The details of the socio-demographic characteristics of the sample are reported in Table 2.

2.2. Procedure

A structured questionnaire (see the Supplementary Materials) was developed using Google form and submitted online via social and electronic media such as Facebook, Instagram, WhatsApp, and e-mails among Italian consumers between December 2021 and July 2022, following the snowball sampling method. The survey followed the ethical standards defined by the Declaration of Helsinki, was developed in Italian, and was approved by the Bioethics Committee of the University of Turin (Prot. n. 0676006). Informed consent was provided by the participants before filling in the questionnaire. The filling time was 15–20 min. The only exclusion criterion was the respondent's age lower than 18 years.

The questionnaire included the following measures:

- Biospheric Values (de Groot and Steg, 2008; Stern, 2008): this scale was composed of four items (i.e., Protecting the environment: preserving nature; Unity with nature: feeling part of the natural environment; Preventing pollution: protecting natural resources;

Table 2
Socio-demographic characteristics of the sample (n = 1402).

Sex	N.	Percentage
Female	981	69. 9 %
Male	410	29.3 %
I prefer not to answer	11	0.8 %
Total	1402	100 %
Age		
18–25	315	22.4 %
26–35	301	21.4 %
36–45	213	15.2 %
46–55	276	19.7 %
56–65	250	17.8 %
> 65	47	3.5 %
Total	1402	100 %
Educational level		
Primary school	2	0.1 %
Lower secondary school	45	3.2 %
Upper secondary school	472	33.7 %
Master's degree	883	62.9 %
Total	1402	100 %
Current occupation		
Farmer	6	0.4 %
Craftsman	12	0.9 %
Homemaker	37	2.6 %
Trader	7	0.5 %
Unemployed	9	0.6 %
Employee	348	24.7 %
Entrepreneur	25	1.8 %
Teacher/university lecturer	158	11.2 %
Freelancer	153	10.8 %
Retired	58	4.1 %
Health professional	165	11.7 %
Researcher	102	7.2 %
Student	333	23.1 %
Total	1402	100 %

Respecting the earth: harmony with other species) regarding values related to the emphasis on the environment and the biosphere preservation.

- New Human Interdependence Paradigm Scale (NHIP) (Corral-Verdugo et al., 2008): this scale was composed of five items (i.e., True human progress can only be achieved by maintaining ecological balance; Safeguarding nature today means securing the future for mankind; We must reduce our consumption levels to ensure the well-being of present and future generations; Humanity can only progress by safeguarding natural resources; People can only enjoy nature if they make wise use of its resources) related to the interdependence between human progress and nature conservation, that is conceived as a dynamic process of integration and incorporation of human needs into natural processes.
- Attitude Toward Sustainability Scale: this scale, adapted by combining the indexes of the environmental impact of the food chain introduced by Roibás et al. (2015), and the social and economic sustainability indicators included in Merlino et al. (2022), is composed of eight items concerning the attention on sustainability themes (i.e., Organic production method; Use of alternative energies; Biodegradable or recyclable packaging; Carbon footprint certification (for low CO_2 emissions); Water footprint certification (for low water use); Short supply chain; Local origin; Reduced use of chemical compounds (e.g. pesticides).
- Attention to Insect Welfare Scale (adapted from Massaglia et al., 2018, and Delvendahl et al., 2022): this scale was composed of three items (e.g. It is important to protect insect welfare during farming practices; Insect welfare is less important than the welfare of other animals reared; Raising insects in an ethical manner is attributable to higher product quality) tapping insects' welfare perception. The initial Cronbach's Alpha was lower than 0.60. At this purpose, one item was removed from the analysis to reach scale reliability.
- Food Neophobia Scale (FNS) (Sogari et al., 2019): this scale was composed of nine items (i.e., When I eat out, I like to try the most unusual dishes, even if I am not sure I would like them; When preparing food or snacks, I like to try new recipes; I like to eat exotic food or food from different cultures; I prefer to eat new products/foods; I am curious about foods I am not familiar with; I am very trusting of new foods; If I don't know what a type of food is, I don't try it; Ethnic food seems too strange to eat; I am afraid to eat things I have never eaten before). In our research, the tendency of the individual to be attracted by or search for unfamiliar foods was assessed. At this purpose, we chose to calculate a Neophilia score (we reversed some items to compute the Neophilia attitude) because the proposed model focuses on potential positive drivers, such as curiosity, rather than negative drivers, such as fear, that influence intention to insect consumption. In the present study the Pliner and Hobden (1992) 7-point Likert Scale for uniformity of scale responses reasons was employed.
- Social Norms Scale (adaptation from Fornara et al., 2011): this scale was composed of five items (i.e., Most of my loved ones would approve of my choice to try alternative proteins to meat derived from insects; Most of my loved ones would approve of my choice to decrease meat consumption in favor of insect protein consumption) regarding two types of social norms, that is descriptive norms (i.e., what significant others do) and injunctive norms (i.e., beliefs about what is formally prescribed and so significant others' expectations).
- Intention-to-eat insects-based foods Scale 1 (ad hoc created scale): this scale was composed of four items (i.e., I would eat insect products should it become a norm in the city where I live; I would only eat products with insects if they were cooked by prestigious chefs; I would be willing to eat only processed insect products (e.g., cookies, snacks, burgers, etc.) in which the insect is not visible) concerning the intention-to-eat insects-based foods and acceptable conditions linked to this choice.

For all the previous scales, the items were measured on a 7-point Likert scale (from 0 = not all important or completely disagree to 6 = very importhnat or totally agree).

- Intention-to-eat insects-based foods Scale 2 (via visual acceptance, ad hoc created). The IEIBF was measured with one textual variable and a check-all-that-apply (CATA) question structured with eleven pictures of different insect based food (see Table 3). In this latter case, participants were asked to assess their willingness to eat them with the question "Which of the following food would you eat?". Figures were included in the questionnaire and presented to respondents without any description to understand how simple visual judgement could influence the frequency of choice of different dishes. The aim was to assess the acceptability of insect food using a variety of insect dish alternatives, choosing between commercially available ready-made products and products to be prepared, to create a basket of alternatives from which consumers could draw for potential consumption. The ultimate goal was to assess the actual acceptability of different forms of the product: sweet and savoury dishes were proposed, with the insect visible or in flour form, with the whole insect combined with conventional dishes (pasta) or with the insect in flour form that could be used in baked preparations (e.g. muffins) or even in commercially available ready-made products (bars or crackers). In this set of alternatives, the insect was both visible and invisible: in fact, we did not seek a balance between the different types of dishes proposed (visible and invisible insect), but tried to vary as much as possible the shapes and visual appearance with which the insects were presented. In this respect, starting from a set of 11 dishes, the frequency with which individual images were chosen was measured, not the type of dish chosen by the respondent. Individuals could also select the "no choice" option.

Finally, socio-demographic characteristics, such as age, sex, nationality, family size, education, and average family annual income, were also collected.

2.3. Data analysis

The internal consistency and reliability of the scales were tested using Cronbach's formula considering an acceptable α value higher than 0.80. The reproducibility was tested using Pearson's correlation analysis.

Descriptive statistics and correlations between variables considering the averaged scores (Pearson's *r*) were calculated using SPSS 27. Structural Equation Modelling (SEM) analysis was run through the AMOS 22 software (Arbuckle, 2013). In the present study, the structural model was composed of two exogenous latent variables (i.e., Biospheric values and Social Norms), six endogenous ones (i.e., New Interdependence Paradigm, Attitude toward Sustainability, Attention to Insect Welfare, Food Neophilia, Intention to eat insect-based food in verbal form and Intention to eat insect-based food in visual form and two covariates (i.e., Sex and Age). The latent variables composed of more than three items were defined by item parcels, each of which is a composite score reflecting a set of homogeneous items (Kline, 2011). Parceling is commonly used in SEM to have more parsimonious and reliable sets of observed variables (e.g., the score reliability of parcels is generally greater than that for the individual items) and more stable parameter estimates and proper solutions of model fit (Kline, 2011). We aggregated items in a pseudo-random way. In Table 4 we present the model elements in detail.

The initial model included the hypothesized unidirectional arrows among the latent factors, also including the paths between non-proximal variables (Fig. 1). To increase the model fit during the step-by-step improvement process, non-significant parameters were eliminated. For assessing the model fit we considered conventional fit indices in the SEM literature (e.g., see Tabachnick and Fidell, 2007), such as the Root Mean

Table 3
The photos of insects-based foods proposed in the survey. The pictures were found online and represent existing insect-based products on the foreign market.

Insects burger[1]	Insects sandwich[2]	Chocolate with grasshoppers[3]
		
Tartlets with grubs[4]	**Spaghetti with crickets[5]**	**Fried grasshoppers[6]**
		
Muffins with cricket flour[7]	**Fried insects[8]**	**Crackers with cricket flour[9]**
		
Insect protein bars[10]	**Pasta with insect flour[11]**	**No choice**
		

[1] https://www.rte.ie/brainstorm/2021/0524/1223553-insect-based-food-bug-burger-insect-energy-bar/;
[2] https://stock.adobe.com/ch_it/images/close-up-on-a-fried-mealworm-insect-burger/271559936;
[3] van Huis, 2013. *Edible insects. Future prospects for food and feed security*;
[4] van Huis, 2013. *Edible insects. Future prospects for food and feed security*;
[5] https://www.dezeen.com/2014/02/14/entomo-website-design-promotes-insects-as-food/;
[6] https://www.healthline.com/health-news/why-edible-insects-are-the-next-superfood-trend;
[7] https://www.insetticongusto.com/ricette-a-base-di-insetti/muffin-dolci-con-farina-di-grilli-ricetta/;
[8] https://it.123rf.com/photo_67488230.html.
[9] https://www.nicepng.com/ourpic/u2w7u2u2r5o0t4q8_crick-cricket-crackers-box-olive-gourmet-cracker-chips/;
[10] https://solobici.es/barritas-proteicas-de-insectos/;
[11] https://aliainsectfarm.it/tagliatelle-con-farina-di-grillo-alia-insect-farm/.

Square Error of Approximation (RMSEA), the Standardized Root Mean Square Residual (SRMR), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). Sex and Age were inserted in the model as covariates.

3. Results

Preliminary analyses concerned the variables' distribution and multicollinearity, presented in Table 4, and their bivariate correlations (Pearson's *r*), presented in Table 5. Results showed that overall the variables have a tendentially normal distribution and there is no multicollinearity among them ($r < 0.70$), Table 6.

Fig. 2 presents the outcome of the final SEM model, based on the ISNIEM, which shows a good fit (χ^2 206 = 111.02, p = 0.000, TLI = 0.94, CFI = 0.96, SRMR = 0.07, RMSEA = 0.056 [0.053 0.059].

The model accounts for an acceptable proportion of variance (33 % of accounted variance) of the final outcome variable, i.e., Number of chosen IBF, for an acceptable proportion of variance of its main direct antecedent, i.e., IEIBF (22 % of accounted variance), and for an acceptable proportion of variance of Attention to insects welfare (16 % of accounted variance). This latter is in turn predicted by a positive Attitude toward sustainability (10 % of accounted variance), which in turn is predicted by the attitude toward NHIP (46 % of accounted variance). Finally, the model accounts for an acceptable proportion of variance of Food Neophilia (11 % of accounted variance).

About H1, it is confirmed that Biospheric values are positively associated with NHIP (H1: $\beta = 0.68$, $p < 0.001$); this latter is positively associated with a positive Attitude Toward Sustainability (H2: $\beta = 0.09$,

Table 4
The detail of the elements included in the proposed model.

Variables	Indicators
Endogenous	
Biospheric Values	4 items
Social Norms	3 items
Exogenous	
NHIPS	Parcel 1: item 1, 3, 5 Parcel 2: item 2, 4
Attitude Toward Sustainability	Parcel 1: item 1, 4, 7 Parcel 2: 2, 5, 8 Parcel 3: items 3, 6
Attention to Insects Welfare	2 items
IEIBF (verbal form)	3 items
IEIBF (visual form)	11 images
Covariates	
Sex	M/F
Age	Numeric value

$p < 0.001$), and thus H2 is confirmed.

As hypothesized, a positive Attitude Toward Sustainability is positively associated with the Attention to insects welfare (H3: $\beta = 0.35$, $p < 0.001$), and this is in turn associated with the Intention-to-eat insects-based foods (H4: $\beta = 0.10$, $p < 0.001$) and in turn positively associated with the number of different types of insects presented with images (H5: $\beta = 0.30$, $p < 0.001$). Concerning the impact of Food Neophilia and Social Norms, the latter is not associated with the number of insects chosen presented with different images and so H6a is rejected; on the contrary Social Norms are positively associated with the Intention-to-eat insects-based foods (H6b: $\beta = 0.35$, $p < 0.001$) and with Food Neophilia (H6c: $\beta = 0.29$, $p < 0.001$), and so H6b and H6c are confirmed. Food Neophilia is positively associated with the Number of insects chosen presented with different images (H7a: $\beta = 0.31$, $p < 0.001$) and with the Intention-to-eat insects-based foods (H7b: $\beta = 0.16$, $p < 0.001$) and so H7a and H7b are both confirmed. Concerning the role of the covariate Sex, it showed an impact on the Number of insects chosen presented with different images ($\beta = -0.22$, $p < 0.001$), Intention-to-eat insects-based foods ($\beta = -0.06$, $p < 0.001$), Attention to Insect Welfare ($\beta = 0.10$, $p < 0.001$) and positive Attitude Toward Sustainability ($\beta = 0.10$, $p < 0.001$). Concerning the role of the covariate Age, it showed an impact on the Number of insects chosen presented with different images ($\beta = -0.11$, $p < 0.001$), Intention-to-eat insects-based foods ($\beta = -0.12$, $p < 0.001$), Attention to Insect Welfare ($\beta = -0.16$, $p < 0.001$), positive Attitude Toward Sustainability ($\beta = 0.10$, $p < 0.001$) and Food Neophilia ($\beta = -0.12$, $p < 0.001$).

4. Discussion

Entomophagy is common and spread in some Asian, American, and African countries, whilst Western populations generally show aversion and rejection of this eating practice (Toti et al., 2020). Even though the Western world is considered unwilling to adopt entomophagy, treating it

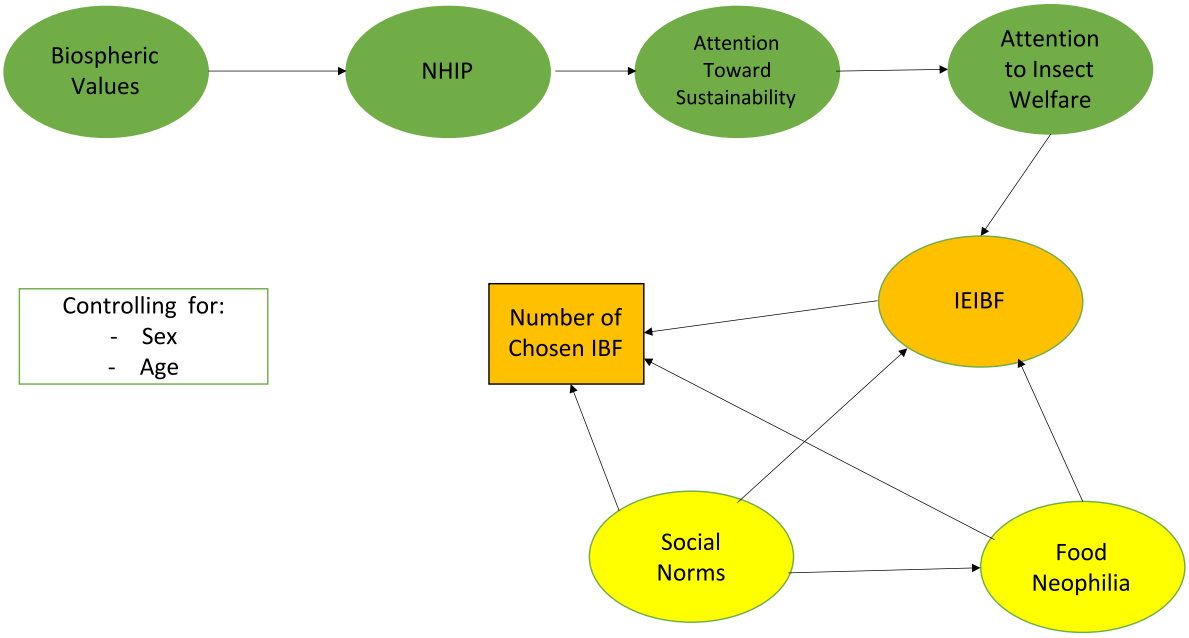

Fig. 1. The Integrated Sustainable Neophilic Insect-based Eating Model (ISNIEM) initial structure.

Table 5
Descriptive statistics concerning the variables under study.

Variables	Min	Max	Mean	S.d.	Sk	K	Cronbach's alpha
Biospheric Values	0	6	5.13	1.13	−1.65	2.54	0.92
NHIP	0	6	5.32	1.041	−2.19	5.10	0.94
Attitude Toward Sustainability	0	6	4.24	1.39	−0.81	0.14	0.93
Attention to Insects Welfare	0	6	4.20	1.39	−0.49	−0.29	0.92
Food Neophilia	0	6	3.67	1.29	−0.42	−0.36	0.87
Social Norms	0	6	1.78	1.41	0.51	−0.48	0.73
IEIBF	0	6	2.55	1.39	−0.48	−0.83	0.63
Number of chosen IBF	0	11	2.60	3.17	1.08	0.13	N.A.

Notes: IEIBF: Intention-to-eat insects-based foods, IBF: Insect Based Foods; NHIP = New Human Interdependence Paradigm; Sk = skewness; K = curtosis.

Table 6
Bivariate correlations matrix (Pearson's r) between the investigated variables.

	Biospheric Values	NHIP	Attitude Toward Sustainability	Attention to Insects Welfare	Food Neophilia	Social Norms	IEIBF	Number of chosen IBF
Biospheric Values	–							
NHIP	0.63**	–						
Attitude Toward Sustainability	0.55**	0.41**	–					
Attention to Insects Welfare	0.33**	0.27**	0.24**	–				
Food Neophilia	0.08**	0.12**	0.08**	0.15**	–			
Social Norms	0.11**	0.12**	0.15**	0.17**	0.26**	–		
IEIBF	−0.02	0.05	−0.02	0.14**	0.38**	0.41**	- -	
Number of chosen IBF	0.02	0.05*	−0.02	0.11**	0.43**	0.33**	0.57**	–

Notes: IEIBF: Intention-to-eat insects-based foods, IBF: Insect Based Foods; **p-value < 0.01; *p -value < 0.05.

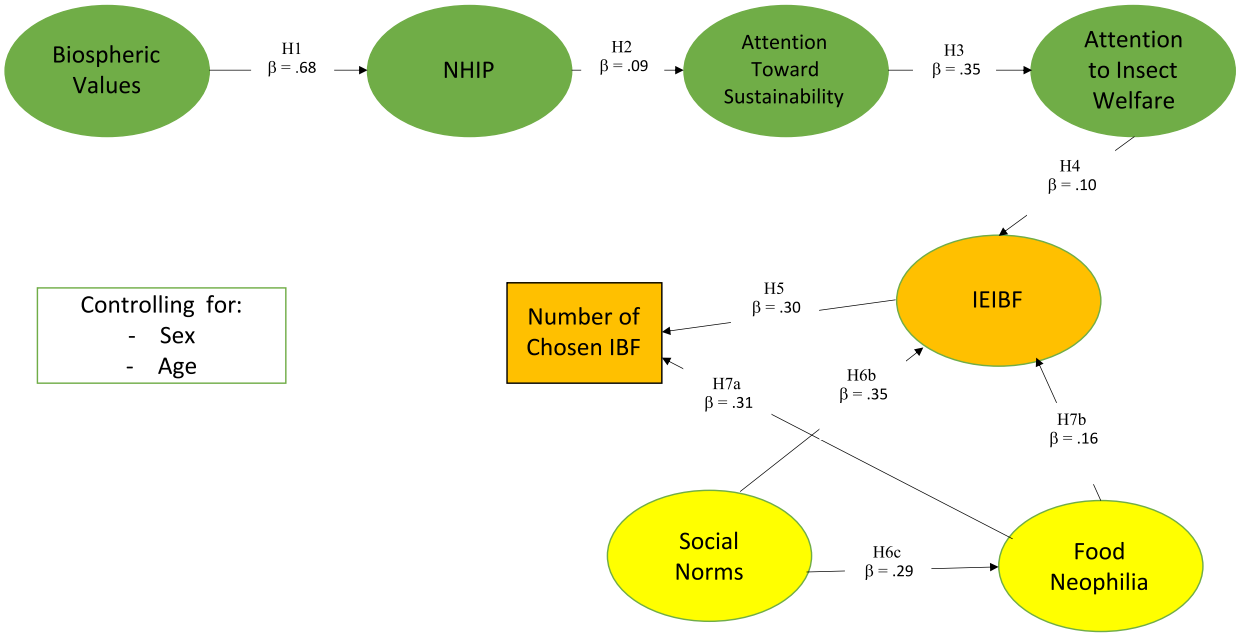

Fig. 2. The final Integrated Sustainable Neophilic Insect-based Eating Model (ISNIEM).

as one uniform food culture is inaccurate (Bisconsin-Júnior et al., 2022). Detailed evaluations of consumer studies expose high levels of variability in attitudes, drivers, and inhibitors of entomophagy among different countries and cultures (Ardoin and Prinyawiwatkul, 2021). Even if Mancini et al. (2019a) showed that Northern European countries - where insect production has widely increased in the last years (Pippinato et al., 2020) - had higher levels of acceptability compared to the Central, Mediterranean, or Western countries, our research outcomes suggest margins of acceptability of IBF for the Italian consumers.

The main findings of our research suggest that the Intention-to-eat insects-based foods is driven by two distinct paths.

The first path of the model is represented by a sequential chain of variables related to the environment: the intention-to-eat insect based foods is related to the attention to insect welfare, which in turn is predicted by a positive attitude towards sustainability, which in turn is predicted by concern directly related to the interdependence between human progress and nature conservation, and this latter is linked to the displaying of biospheric values. This shows that individuals who are more sensitive to aspects of environmental and ethical sustainability issues are more open to taste insects, especially if they believe that they are treated ethically. Other researchers showed that in Italy the beliefs around the positive effects on health has a stronger influence on behavioral intentions compared to beliefs about environmental protection (Wendin & Nyberg, 2021; Mancini et al., 2019b; Palmieri et al., 2023). As explored in Spartano and Grasso (2021), sustainable consumers can interpret aspects such as animal welfare as a mediator between product and convenience. Our research echoes the results of previous studies conducted in North and Central Europe through visual representations of Insects based foods: consumers were driven by both curiosity and demand for variety and a sense of responsibility toward the environment: the attention toward sustainability of production, as well as animal rights (Lähteenmäki-Uutela et al., 2018; Piha et al., 2018; Sparacino et al., 2023).

About the second path of the model, i.e. the one considering Food Neophilia and Social Norms, Food Neophilia showed the strongest association with the final outcome, i.e. the number of insects chosen by individuals presented via images. On the contrary, Social Norms were not associated directly with this latter variable but they were positively associated with both Food Neophilia and Intention-to-eat insects-based foods. Regarding the curiosity toward new foods, having a generalist diet, which is the characteristics of the majority of our sample, allows humans to occupy a wide range of environmental niches. However, this flexibility in food preferences creates an adaptive challenge absent in dietary specialists; that of discriminating and choose between multiple food resources. This challenge has been labeled the "omnivore's dilemma" and refers to the evolutionary problem of balancing openness to new and diverse foods (i.e., neophilia), with the fear and aversion to them (i.e., neophobia). Our model showed that Food Neophilia was

predicted by Social Norms, but it has to be considered that the role of social norms in a culture where entomophagy is neither typical nor widespread could have weakened their weight on the intention to taste different types of insects. Learning from the people in one's local environment that insects are good to eat, or how to make them so, could be likely less costly and risky than adopting an individual approach like trial-and-error, so long as this information is accessible and reliable (Cruz and Celis Peniche, 2022), but this food norms are absent in Italian culture. For example, in a study conducted by Sogari (2015), the majority of participants reported that entomophagy would not be approved by their family and friends. Menozzi et al. (2017) found that subjective norms did not predict behavioral intentions to eat insect flour in the future and participants in their study declared an incompatibility among local food values and culture and consuming insect-based products. This result is, however, unsurprising, because there is no broad cultural impetus to eat insects, given that entomophagy is not practiced in Europe. In the same study, Menozzi et al. (2017) did not find a significant correlation between subjective social norms and actual insect-eating behavior at a subsequent bug banquet. This result might, however, be caused by attendance to the bug banquet being a matter of individual choice, and not socially contextualized. Conformity to local social norms may also explain why tailoring novel insects' food to match familiar foods could improve their acceptance (Caparros Megido et al., 2018; Merlino et al., 2021). Presenting Western consumers with edible insects in a familiar presentation or preparation (e.g., pizza with insect flour), or using familiar flavors and accompanying ingredients reduces neophobic responses, but these effects are highly variable (Caparros Megido et al., 2018, Tuccillo et al., 2020; Sogari et al., 2023). It is worth noticing that at the time of data collection, the topic was not so spread and represented by the media, while exactly in this period the news of the first commercialized insect-based products in Italy received large attention in the communication arena. Existing literature showed that psychological, sociological, and anthropological factors play conjunctly a fundamental role in the choice of insect based products by Italian consumers, who are influenced by attachment to tradition (Poli et al., 2019) and for these reasons these factors should be investigated in future analysis.

5. Conclusions

In conclusion, our research shows how the complex nutritional transition from traditional animal protein sources to IBFs should probably start by projecting the market towards a specific target of receptive consumer groups that include informed consumers who are relatively highly involved with environmental and social concerns such as animal welfare when choosing foods. The lack of confidence in the product and the limited consumer knowledge of insects as food suggest strategies to increase consumer curiosity about consumption, which we have seen to be among the main drivers of IEIBF.

In addition, the marketing image of insect foods could be improved, e.g. by better preparation methods and meal concepts, possibly inspired by creative and common (traditional) meals in which the insect is not visible in the eyes of the consumer.

Among the limitations of this research is certainly the non-representativeness of the Italian population due to the snowball sampling procedure adopted. Another limitation is that our interest raised from the recently EU regulation about the introduction of IBF in EU market but we cannot be sure that our model can be extended in other geoghraphical contexts. In this regard, starting from the results of Bisconsin-Júnior et al. (2022), which show how cultural variability even within the same country and regional culture seem to influence the way people approach entomophagy, in our future research it will be important to extend our study to other countries to assess how traditional values, such as dietary style, might influence the intention to eat insect-based foods using ISNIEM. Another limitation is that we used a 9-item version of the FNS as Sogari et al. (2019) and in this way we excluded one item a priori. Future studies should use the original number of items, which are ten.

Finally, we can conclude with a quote from Rappoport (2003), who declared - in relation to the social and psychological aspects of attitude toward food claims - that "consciously or not, when we eat we swallow not only a certain alimentary product, but also the concept, the culture, and the land to which it is associated with". This seems even more true for average Italian consumers, less so for the more curious and greener.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical statement

Approval for the involvement of human subjects in this study was granted by the University Bioethics Committee of the University of Turin (Prot. n. 0676006), 12/14/2021. The study was explained to consumers in the online questionnaire. They were informed that they would participate in the survey using their personal smartphone and that all data will be de-identified and only reported in the aggregate. All participants acknowledged an informed consent statement in order to participate in the study.

CRediT authorship contribution statement

Merlino Maria Valentina: Conceptualization, Methodology, Validation, Writing – review & editing, Formal analysis, Writing – original draft, Visualization, Data curation, Project administration. **Mosca Oriana:** Conceptualization, Methodology, Validation, Writing – review & editing, Formal analysis, Writing – original draft, Visualization, Data curation, Project administration. **Fornara Ferdinando:** Conceptualization, Methodology, Validation, Writing – review & editing, Formal analysis, Writing – original draft, Visualization, Data curation, Project administration. **Roma Rocco:** Writing – review & editing, Project administration. **Elisabetta Bonerba:** Project administration. **Achille Schiavone:** Writing – review & editing. **Rosa Laura Passaro:** Formal analysis, Writing – original draft. **Martina Tarantola:** Conceptualization, Writing – review & editing, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

We thank Roberta Cois for her help in the data collection phase.

Dr. Valentina Maria Merlino worked at this research within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2023.105040.

References

Arbuckle, J. (2013). *AMOS 22*. IL SmallWaters Corp: Chic.

Ardoin, R., & Prinyawiwatkul, W. (2021). Consumer perceptions of insect consumption: a review of western research since 2015. *Int. J. Food Sci. Technol., 56*, 4942–4958. https://doi.org/10.1111/ijfs.15167

Balzan, S., Fasolato, L., Maniero, S., & Novelli, E. (2016). Edible insects and young adults in a north-east Italian city an exploratory study. *Br. Food J., 118*, 318–326. https://doi.org/10.1108/BFJ-04-2015-0156

Bisconsin-Júnior, A., Rodrigues, H., Behrens, J. H., da Silva, M. A. A. P., & Mariutti, L. R. B. (2022). "Food made with edible insects": exploring the social representation of entomophagy where it is unfamiliar. *Appetite, 173*, Article 106001. https://doi.org/10.1016/j.appet.2022.106001

Caparros Megido, R., Gierts, C., Blecker, C., Brostaux, Y., Haubruge, É., Alabi, T., & Francis, F. (2016). Consumer acceptance of insect-based alternative meat products in Western countries. *Food Qual. Prefer., 52*, 237–243. https://doi.org/10.1016/j.foodqual.2016.05.004

Caparros Megido, R., Haubruge, É., & Francis, F. (2018). Insects, the next European foodie craze? *Edible Insects Sustain. Food Syst.*, 353–361.

Choe, J. Y., (Jacey), Kim, J. J., & Hwang, J. (2020). The environmentally friendly role of edible insect restaurants in the tourism industry: applying an extended theory of planned behavior. *Int. J. Contemp. Hosp. Manag., 32*, 3581–3600. https://doi.org/10.1108/IJCHM-04-2020-0352

Cicatiello, C., De Rosa, B., Franco, S., & Lacetera, N. (2016). Consumer approach to insects as food: barriers and potential for consumption in Italy. *Br. Food J., 118*, 2271–2286. https://doi.org/10.1108/BFJ-01-2016-0015

Corral-Verdugo, V., Carrus, G., Bonnes, M., Moser, G., & Sinha, J. B. (2008). Environmental beliefs and endorsement of sustainable development principles in water conservation: toward a new human interdependence paradigm scale. *Environ. Behav., 40*, 703–725.

y Celis, C., & Peniche, P. (2022). Drivers of insect consumption across human populations. *Evol. Anthropol. Issues News Rev., 31*, 45–59. https://doi.org/10.1002/evan.21926

de Boer, J., & Aiking, H. (2022). Considering how farm animal welfare concerns may contribute to more sustainable diets. *Appetite, 168*, Article 105786. https://doi.org/10.1016/j.appet.2021.105786

de Groot, J. I. M., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: how to measure egoistic, altruistic, and biospheric value orientations. *Environ. Behav., 40*, 330–354. https://doi.org/10.1177/0013916506297831

Delvendahl, N., Rumpold, B. A., & Langen, N. (2022). Edible insects as food-insect welfare and ethical aspects from a consumer perspective. *Insects, 13*, 121. https://doi.org/10.3390/insects13020121

Demartini, E., Vecchiato, D., Finos, L., Mattavelli, S., & Gaviglio, A. (2022). Would you buy vegan meatballs? the policy issues around vegan and meat-sounding labelling of plant-based meat alternatives. *Food Policy, 111*, Article 102310. https://doi.org/10.1016/j.foodpol.2022.102310

D'Souza, C. (2022). Game meats: Consumption values, theory of planned behaviour, and the moderating role of food neophobia/neophiliac behaviour. *J. Retail. Consum. Serv., 66*, Article 102953. https://doi.org/10.1016/j.jretconser.2022.102953

Fitches, E. C., & Smith, R. (2018). PROteINSECT: Insects as a Sustainable Source of Protein. In A. Halloran, R. Flore, P. Vantomme, & N. Roos (Eds.), *Edible Insects in Sustainable Food Systems* (pp. 421–433). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-74011-9_26.

Florença, S. G., Guiné, R. P. F., Gonçalves, F. J. A., Barroca, M. J., Ferreira, M., Costa, C. A., … Cunha, L. M. (2022). The motivations for consumption of edible insects: a systematic review. *Foods, 11*, 3643. https://doi.org/10.3390/foods11223643

Fornara, F., Carrus, G., Passafaro, P., & Bonnes, M. (2011). Distinguishing the sources of normative influence on proenvironmental behaviors: the role of local norms in household waste recycling. *Group Process. Intergroup Relat., 14*, 623–635.

Gasco, L., Biasato, I., Dabbou, S., Schiavone, A., & Gai, F. (2019). Quality and Consumer Acceptance of Products from Insect-Fed Animals. In G. Sogari, C. Mora, & D. Menozzi (Eds.), *Edible Insects in the Food Sector: Methods, Current Applications and Perspectives* (pp. 73–86). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-22522-3_6.

Hartmann, C., & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: a systematic review. *Trends Food Sci. Technol., 61*, 11–25. https://doi.org/10.1016/j.tifs.2016.12.006

IPIFF, 2020. The Insect Sector Milestones towards Sustainable Food Supply Chains.

IPIFF, 2019. The European Insect Sector Today: Challenges, Opportunities and Regulatory Landscape. IPIFF Vision Paper on the Future of the Insect Sector towards 2030.

IPIFF, 2018. Contribution on the Development of a European Protein Plan. 2018.

Kline, R. B. (2011). *Principles and practice of structural equation modeling*. New York: Guilford Press.

Kwiecińska, K., Kosicka-Gębska, M., Gębski, J., & Gutkowska, K. (2017). Prediction of the conditions for the consumption of game by Polish consumers. *Meat Sci., 131*, 28–33. https://doi.org/10.1016/j.meatsci.2017.04.038

Lähteenmäki-Uutela, A., Hénault-Ethier, L., Marimuthu, S. B., Talibov, S., Allen, R. N., Nemane, V., … Józefiak, D. (2018). The impact of the insect regulatory system on the insect marketing system. *J. Insects Food Feed, 4*, 187–198.

Laureati, M., Proserpio, C., Jucker, C., & Savoldelli, S. (2016). New sustainable protein sources: Consumers'willingness to adopt insects as feed and food. *Ital. J Food Sci, 28*.

Lombardi, A., Vecchio, R., Borrello, M., Caracciolo, F., & Cembalo, L. (2019). Willingness to pay for insect-based food: the role of information and carrier. *Food Qual. Prefer., 72*, 177–187. https://doi.org/10.1016/j.foodqual.2018.10.001

Mancini, S., Moruzzo, R., Riccioli, F., & Paci, G. (2019a). European consumers' readiness to adopt insects as food. A review. *Food Res. Int., 122*, 661–678. https://doi.org/10.1016/j.foodres.2019.01.041

Mancini, S., Sogari, G., Menozzi, D., Nuvoloni, R., Torracca, B., Moruzzo, R., & Paci, G. (2019b). Factors predicting the intention of eating an insect-based product. *Foods, 8*, 270.

Massaglia, S., Merlino, V., & Borra, D. (2018). Marketing strategies for animal welfare meat identification: Comparison of preferences between millennial and conventional consumers. *Calitatea-Acces Succes, 19*, 305–311.

Materia, V. C., & Cavallo, C. (2015). Insetti per l'alimentazione umana: Barriere e drivers per l'accettazione da parte dei consumatori. *Ital. Rev. Agric. Econ., 70*, 139–161.

Menozzi, D., Sogari, G., Veneziani, M., Simoni, E., & Mora, C. (2017). Eating novel foods: an application of the theory of planned behaviour to predict the consumption of an insect-based product. *Food Qual. Prefer., 59*, 27–34. https://doi.org/10.1016/j.foodqual.2017.02.001

Merlino, V. M., Borra, D., Girgenti, V., Dal Vecchio, A., & Massaglia, S. (2018). Beef meat preferences of consumers from Northwest Italy: analysis of choice attributes. *Meat Sci., 143*, 119–128.

Merlino, V. M., Mosca, O., Blanc, S., Sparacino, A., Massaglia, S., Borra, D., … Fornara, F. (2023). The role of socio-demographic variables and buying habits in determining milk purchasers' preferences and choices. *Front. Nutr., 10*, 1072208. https://doi.org/10.3389/fnut.2023.1072208

Merlino, V. M., Mota-Gutierrez, J., Borra, D., Brun, F., Cocolin, L., Blanc, S., & Massaglia, S. (2021). Chocolate culture: Preferences, emotional implications and awareness of Italian consumers. *International Journal of Gastronomy and Food Science, 25*, 100374.

Merlino, V. M., Renna, M., Nery, J., Muresu, A., Ricci, A., Maggiolino, A., … Tarantola, M. (2022). Are local dairy products better? using principal component analysis to investigate consumers' perception towards quality, sustainability, and market availability. *Animals, 12*, 1421. https://doi.org/10.3390/ani12111421

Myers, G., & Pettigrew, S. (2018). A qualitative exploration of the factors underlying seniors' receptiveness to entomophagy. *Food Res. Int., 103*, 163–169. https://doi.org/10.1016/j.foodres.2017.10.032

Onwezen, M. C., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2021). A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite, 159*, Article 105058. https://doi.org/10.1016/j.appet.2020.105058

Palmieri, N., Nervo, C., & Torri, L. (2023). Consumers' attitudes towards sustainable alternative protein sources: comparing seaweed, insects and jellyfish in Italy. *Food Qual. Prefer., 104*, Article 104735. https://doi.org/10.1016/j.foodqual.2022.104735

Palmieri, N., Perito, M. A., Macrì, M. C., & Lupi, C. (2019). Exploring consumers' willingness to eat insects in Italy. *Br. Food J., 121*, 2937–2950. https://doi.org/10.1108/BFJ-03-2019-0170

Piha, S., Pohjanheimo, T., Lähteenmäki-Uutela, A., Křečková, Z., & Otterbring, T. (2018). The effects of consumer knowledge on the willingness to buy insect food: an exploratory cross-regional study in Northern and Central Europe. Food Qual. Prefer. *Seventh European Conference on Sensory and Consumer Research, 70*, 1–10. https://doi.org/10.1016/j.foodqual.2016.12.006

Pippinato, L., Gasco, L., Di Vita, G., & Mancuso, T. (2020). Current scenario in the European edible-insect industry: a preliminary study. *J. Insects Food Feed, 6*, 371–381. https://doi.org/10.3920/JIFF2020.0008

Poli, A., Agostoni, C., Graffigna, G., Bosio, C., Donini, L. M., & Marangoni, F. (2019). The complex relationship between diet, quality of life and life expectancy: a narrative review of potential determinants based on data from Italy. *Eat. Weight Disord. - Stud Anorex. Bulim. Obes., 24*, 411–419. https://doi.org/10.1007/s40519-018-0582-2

Rappoport, L. (2003). *Come mangiamo: Appetito, cultura e psicologia del cibo* (p. 40). Ponte alle Grazie. p: Milano.

Roibás, L., Elbehri, A., & Hospido, A. (2015). Evaluating the sustainability of ecuadorian bananas: carbon footprint, water usage and wealth distribution along the supply chain. *Sustain. Prod. Consum., Sustainability issues in the food–energy–water nexus, 2*, 3–16. https://doi.org/10.1016/j.spc.2015.07.006

Roma, R., Ottomano Palmisano, G., & De Boni, A. (2020). Insects as novel food: a consumer attitude analysis through the dominance-based rough set approach. *Foods, 9*, 387. https://doi.org/10.3390/foods9040387

Santeramo, F. G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R., & Nardone, G. (2018). Emerging trends in European food, diets and food industry. *Food Res. Int., 104*, 39–47.

Schouteten, J. J., De Steur, H., De Pelsmaeker, S., Lagast, S., Juvinal, J. G., De Bourdeaudhuij, I., … Gellynck, X. (2016). Emotional and sensory profiling of insect-, plant- and meat-based burgers under blind, expected and informed conditions. *Food Qual. Prefer., 52*, 27–31. https://doi.org/10.1016/j.foodqual.2016.03.011

Smith, J. R. (2020). Group norms. *In Oxford research encyclopaedia of psychology*. https://doi.org/10.1093/acrefore/97801902365

Sogari, G. (2015). Entomophagy and Italian consumers: An exploratory analysis. *Prog. Nutr., 17*, 311–316.

Sogari, G., Menozzi, D., & Mora, C. (2019). The food neophobia scale and young adults' intention to eat insect products. *Int. J. Consum. Stud., 43*, 68–76. https://doi.org/10.1111/ijcs.12485

Sogari, G., Riccioli, F., Moruzzo, R., Menozzi, D., Sosa, D. A. T., Li, J., … Mancini, S. (2023). Engaging in entomophagy: the role of food neophobia and disgust between insect and non-insect eaters. *Food Quality and Preference, 104*, Article 104764.

Sottile, F., Massaglia, S., Merlino, V. M., Peano, C., Mastromonaco, G., Fornara, F., … Mosca, O. (2023). Consumption vs. non-consumption of plant-based beverages: A

case study on factors influencing consumers' choices. *AIMS Agriculture and Food, 8* (3), 889–913.
Sparacino, A., Merlino, V. M., Borra, D., Massaglia, S., & Blanc, S. (2023). Web content analysis of beekeeping website companies: Communication and marketing strategies in the Italian context. *Journal of Marketing Communications*, 1–22.
Spartano, S., & Grasso, S. (2021). Consumers' perspectives on eggs from insect-fed hens: a UK focus group study. *Foods, 10*, 420. https://doi.org/10.3390/foods10020420
Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues, 50*(3), 65–84.
Stern, P.C., 2008. Environmentally significant behavior in the home, in: The Cambridge Handbook of Psychology and Economic Behaviour. Cambridge University Press, New York, NY, US, pp. 363–382. 10.1017/CBO9780511490118.015.
Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using ANOVA*. CA: Thomson/Brooks/Cole Belmont.
Toti, E., Massaro, L., Kais, A., Aiello, P., Palmery, M., & Peluso, I. (2020). Entomophagy: a narrative review on nutritional value, safety, cultural acceptance and a focus on the role of food neophobia in Italy. *Eur. J. Investig. Health Psychol. Educ., 10*, 628–643. https://doi.org/10.3390/ejihpe10020046
Tuccillo, F., Marino, M. G., & Torri, L. (2020). Italian consumers' attitudes towards entomophagy: influence of human factors and properties of insects and insect-based food. *Food Research International, 137*, Article 109619. https://doi.org/10.1016/j.foodres.2020.109619
Valli, C., Santero, M., Prokop-Dorner, A., Howatt, V., Johnston, B. C., Zajac, J., … Rabassa, M. (2021). Health related values and preferences regarding meat intake: a cross-sectional mixed-methods study. *Int. J. Environ. Res. Public. Health, 18*, 11585. https://doi.org/10.3390/ijerph182111585
van Huis, A. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations, Rome: FAO forestry paper.
Verbeke, W. (2015). Profiling consumers who are ready to adopt insects as a meat substitute in a Western society. *Food Qual. Prefer., 39*, 147–155. https://doi.org/10.1016/j.foodqual.2014.07.008
Wendin, K. M., & Nyberg, M. E. (2021). Factors influencing consumer perception and acceptability of insect-based foods. *Current opinion in food science, 40*, 67–71.
Zielińska, E., Zieliński, D., Karaś, M., & Jakubczyk, A. (2020). Exploration of consumer acceptance of insects as food in Poland. *J. Insects Food Feed, 6*, 383–392. https://doi.org/10.3920/JIFF2019.0055

Further reading

Renna, M., Schiavone, A., Gai, F., Dabbou, S., Lussiana, C., Malfatto, V., … Biasibetti, E. (2017). Evaluation of the suitability of a partially defatted black soldier fly (Hermetia illucens L.) larvae meal as ingredient for rainbow trout (Oncorhynchus mykiss Walbaum) diets. *J. Anim. Sci. Biotechnol., 8*, 1–13.
Schiavone, A., Dabbou, S., Marco, M. D., Cullere, M., Biasato, I., Biasibetti, E., … Gasco, L. (2018). Black soldier fly larva fat inclusion in finisher broiler chicken diet as an alternative fat source. *Animal, 12*, 2032–2039. https://doi.org/10.1017/S1751731117003743